

WHAT IS CLAIMED IS:

1. A method of removing contaminants from a silicon wafer after a chemical-mechanical polishing operation, comprising :

5 performing a buffer-polishing process by passing an aqueous solution of ozone over the silicon wafer.

2. The method of claim 1, wherein a concentration of ozone in the aqueous solution is between about 10 ppm and 200 ppm.

3. The method of claim 1, wherein performing a buffer-polishing process includes providing an inertial mechanical force of between about 0.5 psi and 3 psi.

10 4. The method of claim 1, wherein the buffer-polishing process is conducted after a metallic layer chemical-mechanical polishing process.

5. The method of claim 1, wherein the buffer-polishing process is conducted after a barrier layer chemical-mechanical polishing process.

15 6. The method of claim 1, wherein before performing the buffer-polishing process, the aqueous ozone solution is catalyzed to produce more free ozone radicals therein.

7. The method of claim 6, wherein the aqueous ozone solution is catalyzed by exposure to a beam of ultraviolet light or addition of hydrogen peroxide thereto.

8. A method of forming a dual damascene structure, comprising:

20 providing a substrate;

forming a dielectric layer over the substrate;

patterning the dielectric layer to form an opening that exposes a portion of the substrate;

forming an etching stop layer over the substrate, wherein the etching stop layer

is conformal to a surface profile of the substrate;

removing the etching stop layer within the opening by photolithographic and etching techniques;

forming a barrier layer over the substrate, wherein the barrier layer is conformal
5 to the surface profile of the substrate and covers the etching stop layer;

forming a metallic layer over the barrier layer so that the opening is completely filled;

performing metallic layer chemical-mechanical polishing to remove a portion of the metallic layer and expose the barrier layer;

10 performing barrier layer chemical-mechanical polishing to remove a portion of the barrier layer and expose the dielectric layer; and

performing a buffer-polishing process by passing thereover an aqueous solution of ozone so that contaminants on a surface of the wafer are removed.

9. The method of claim 8, wherein after metallic layer chemical-mechanical
15 polishing but before barrier layer chemical-mechanical polishing, further includes:

performing a second buffer-polishing process by passing an aqueous solution of ozone over the silicon wafer.

10. The method of claim 9, wherein a concentration of ozone in the aqueous solution is between about 10 ppm and 200 ppm and performing the second buffer-
20 polishing process includes providing an inertial mechanical force of between about 0.5 psi and 3 psi.

11. The method of claim 9, wherein before performing the first buffer-polishing process or before performing the second buffer-polishing process further includes catalyzing the aqueous ozone solution to produce more free ozone radicals in

the solution.

12. The method of claim 11, wherein the aqueous ozone solution is catalyzed by exposure to a beam of ultraviolet light or addition of hydrogen peroxide thereto.

13. The method of claim 8, wherein a concentration of ozone in the aqueous
5 solution is between about 10 ppm and 200 ppm and performing the first buffer-polishing process includes providing an inertial mechanical force of between about 0.5 psi and 3 psi.

14. The method of claim 8, wherein the dielectric layer includes a low dielectric constant material layer and the metallic layer includes a copper layer.

10 15. A method of forming a dual damascene structure, comprising:
providing a substrate;
forming a dielectric layer over the substrate;
patterning the dielectric layer to form an opening that exposes a portion of the
substrate;
15 forming an etching stop layer over the substrate, wherein the etching stop layer is conformal to a surface profile of the substrate;
removing the etching stop layer within the opening by photolithographic and etching techniques;
forming a barrier layer over the substrate, wherein the barrier layer is conformal
20 to the surface profile of the substrate and covers the etching stop layer;
forming a metallic layer over the barrier layer so that the opening is completely filled;
performing metallic layer chemical-mechanical polishing to remove a portion of the metallic layer and expose the barrier layer;

performing barrier layer chemical-mechanical polishing to remove a portion of the barrier layer and expose the dielectric layer; and

performing a water-cleaning operation by passing an aqueous solution containing ozone over the silicon wafer so that the substrate is surface-treated.

5 16. The method of claim 15, wherein a concentration of ozone in the aqueous solution is between about 10 ppm and 200 ppm.

17. The method of claim 15, wherein the water-cleaning step includes providing an inertial mechanical force of between about 0.5 psi and 3 psi.

10 18. The method of claim 15, wherein the aqueous ozone solution is catalyzed before performing the water-cleaning process to produce more free ozone radicals therein.

19. The method of claim 18, wherein the aqueous solution is catalyzed by exposure to a beam of ultraviolet light or addition of hydrogen peroxide thereto.

15 20. The method of claim 15, wherein the dielectric layer includes a low dielectric constant material layer and the metallic layer includes a copper layer.